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(54) METHOD AND APPARATUS FOR PRODUCING OPTICAL DISC

(57)Abstract:
PURPOSE: To simplify the cutting process by irradiating an optical disc with continuously oscillating laser light subjected to intensity modulation and forming a signal groove therein thereby eliminating the step for applying photoresist and the step for development.
CONSTITUTION: A single mode continuous oscillation laser light is fed from a UV laser light source 1 through a mirror 2 to an acoustooptical modulation element 3 where the laser light is subjected to intensity modulation with a signal fed from a formatter 4 and outputted as an optical modulation pulse. It is fed through a mirror 5 to a beam expander 6 where the beam diameter is enlarged and the beam passes through mirrors 78 and impinges on the incident pupil face of an objective lens 9 before being condensed onto an original optical disc 13 with a spot size of diffraction limit by adjusting the focus. An optical system including a lens 9 is then shifted from the outer circumference to the center in order to expose the original disc 13 spirally thus recording signals through abrasion.

CLAIMS

[Claim(s)]
[Claim 1]An optical disc manufacturing method carrying out intensity modulation of the continuous-oscillation ultraviolet laser

beamirradiating with itand forming a signal slot on an optical disc which absorbs ultraviolet laser radiationand in which a signal slot is formed by from **.
[Claim 2]The optical disc manufacturing method according to claim 1wherein the above-mentioned optical disc is formed with a synthetic resin material.
[Claim 3]The optical disc manufacturing method according to claim 1 with which the above-mentioned optical disc is characterized by applying photoresist material on a glass substrate.
[Claim 4]The optical disc manufacturing method according to claim 1wherein the above-mentioned ultraviolet laser radiation is a far-ultraviolet laser beam by the 4th harmonic generation of neodium YAGU (Nd:YAG) laser.
[Claim 5]The optical disc manufacturing method according to claim 1 playing a signal using an optical pickup from a signal slot immediately after forming of the above-mentioned ultraviolet laser radiationand controlling irradiation time to the above-mentioned optical disc of the above-mentioned ultraviolet laser radiation based on this regenerative signal.
[Claim 6]The optical disc manufacturing method according to claim 1 performing a tracking servo using an adjoining signal slot formed of the above-mentioned ultraviolet laser radiation.
[Claim 7]The optical disc manufacturing method according to claim 1 performing a spindle servo using a signal slot or an adjoining signal slot immediately after forming of the above-mentioned ultraviolet laser radiation.
[Claim 8]A laser light source which ejects a continuous-oscillation ultraviolet laser beamand a modulation means which modulates intensity of ultraviolet laser radiation from the above-mentioned laser light sourceAn optical means converged on a master optical disk which absorbs ultraviolet laser radiation from the above-mentioned modulation meansand in which a signal slot is formed by from **An optical disc manufacturing installation having a control means which controls irradiation time of the above-mentioned ultraviolet laser radiation to the above-mentioned optical discand forming a signal slot on the above-mentioned optical disc.
[Claim 9]The optical disc manufacturing installation according to claim 8wherein the above-mentioned optical disc is formed with a synthetic resin material.
[Claim 10]The optical disc manufacturing installation according to claim 8 to which the above-mentioned optical disc is characterized by applying

photoresist material on a glass substrate.
[Claim 11]The optical disc manufacturing installation according to claim 8wherein the above-mentioned ultraviolet laser radiation is a far-ultraviolet laser beam by the 4th harmonic generation of neodium YAGU (Nd:YAG) laser.
[Claim 12]The optical disc manufacturing installation according to claim 8 playing a signal using an optical pickup from a signal slot immediately after forming of the above-mentioned ultraviolet laser radiationand controlling irradiation time to the above-mentioned optical disc of the above-mentioned ultraviolet laser radiation based on this regenerative signal.
[Claim 13]The optical disc manufacturing installation according to claim 8 performing a tracking servo using an adjoining signal slot formed of the above-mentioned ultraviolet laser radiation.
[Claim 14]The optical disc manufacturing installation according to claim 8 performing a spindle servo using a signal slot or an adjoining signal slot immediately after forming of the above-mentioned ultraviolet laser radiation.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application]This invention relates to the optical disc manufacturing method and optical disc manufacturing installation for forming an information signal in an optical disc.
[0002]
[Description of the Prior Art]a former and disk-like optical recording intermediation object -- a phase-change optical diskan optical magnetism type disketc. exist in what is called an optical disc as a write once optical disk or a reversible type optical disc.
[0003]When producing the master optical disk used in order to reproduce this optical disc in large quantities and to form itthickness applies first the photoresist material which is about 0.1 micrometer on a glass substrate. Nextthe groove which is a guide pattern for trackingand a record signal sloti.e.a pitare formed by a master optical disk exposure device ******** cutting machine on this glass substrate. At this timethe laser beam of wavelength which exposes photoresist materialfor examplethe helium-Cd laser whose wavelength lambda is 441 nmis extracted to the spot size of a diffraction limit with the object lens which is a

condenserand it glares on the above-mentioned photoresist materialand exposes.
[0004]Thena groove and a pit are formed by performing the development which removes the portion exposed with the alkali developing solution of exclusive use [the photoresist material exposed / above-mentioned].
[0005]In order to manufacture an optical disc in large quantitieselectroless deposition and electroforming are performed to the master optical disk by which the development was carried out [above-mentioned]metal duplicates are takenand a master disc is produced. The injection molding machine has reproduced the resin diskusing this metal duplicate as metallic mold ******** La Stampa. To the field where the information signal of the optical disc produced [above-mentioned] was recordedvacuum deposition of the metal membrane for reflection is carried outand the duplicate of an optical disc accomplishes by forming a protective layer by hard resin to it.
[0006]Herethe size of the above-mentioned pit formed is determined by the intensity of the laser beam used for pit formationthe size of the spot of the laser beam irradiated on the above-mentioned photoresista modulating-signal waveformthe number of rotations of a master optical disketc. For examplethe size of the pit of the present optical disc is 0.4 micrometer in widthis 0.8-3.2 micrometers in lengthand is about 0.1 micrometer in depth.
A record signal is expressed by the length of this pit.

[0007]
[Problem(s) to be Solved by the Invention]By the wayto perform signal record to a master optical disk preciselyit is necessary to stop change and dispersion of the length of a piti.e.pit lengthto the minimum. Howeverchange and dispersion of this pit length are produced with the instability of the process of performing the development mentioned above.
[0008]Since the glass used for a master optical disk is expensiveafter being reworkedit is again used for the master optical diskbut a high air cleanliness class is required for the reprocessing steps for this reuse. These reprocessing steps are wet process which uses a drug solutionand since the accuracy of the thickness of the photoresist material formed on this glass is severesevere process control and quality control are needed.
[0009]Also in the developing process mentioned abovesevere process control and quality control of the concentration control of a drug solutionadvance stop detection of developmentetc. are needed.
[0010]The burden of the cost for the time concerning the space and

reprocessing steps of the clean room which the device for two or more processessuch as a device of the process of forming a signaland processing equipmentis neededand is provided with the device of the process of these plurality on a master optical disk is heavy.
[0011]Moreoverin the exposure device of the conventional master optical diskthrough a developing processing stageif it is not after the pit and the groove were formed on the master optical diskthe signal formed state cannot be inspected directly.
[0012]Thenwhen manufacturing a master optical disk in view of the actual condition above-mentioned [this invention]Change and dispersion of pit length which are formed are lostand the optical disc manufacturing installation using the optical disc manufacturing method which can reduce management of two or more down stream processing and these down stream processingand this method is provided.
[0013]
[Means for Solving the Problem]On an optical disc which absorbs ultraviolet laser radiation and in which a signal slot is formed by from **an optical disc manufacturing method concerning this invention carries out intensity modulation of the continuous-oscillation ultraviolet laser beamirradiates with itand solves a technical problem mentioned above by forming a signal slot.
[0014]A laser light source from which an optical disc manufacturing installation concerning this invention ejects a continuous-oscillation ultraviolet laser beamA modulation means which modulates intensity of ultraviolet laser radiation from the above-mentioned laser light sourceand an optical means converged on a master optical disk which absorbs ultraviolet laser radiation from the above-mentioned modulation meansand in which a signal slot is formed by from **It has a control means which controls irradiation time of the above-mentioned ultraviolet laser radiation to the above-mentioned optical discand a signal slot is formed on the above-mentioned optical disc.
[0015]Hereas for the above-mentioned optical disca synthetic resin material or photoresist material is applied on a glass substrate.
[0016]As the above-mentioned synthetic resin materialpolycarbonate resin etc. are suitable.
[0017]As for the above-mentioned optical discit is preferred to use as a master optical disk at the time of manufacturing a master disc used when reproducing an optical disc in large quantities.
[0018]The above-mentioned ultraviolet laser radiation is characterized by being a far-ultraviolet laser beam by the 4th harmonic generation of neodium YAGU (Nd:YAG) laser.

[0019]A signal is played using an optical pickup from a signal slot immediately after forming of the above-mentioned ultraviolet laser radiationand irradiation time to the above-mentioned optical disc of the above-mentioned ultraviolet laser radiation is controlled based on this regenerative signal.
[0020]A spindle servo is performed using a signal slot or an adjoining signal slot immediately after having performed a tracking servo using an adjoining signal slot formed of the above-mentioned ultraviolet laser radiationand moreoverforming of the above-mentioned ultraviolet laser radiation.
[0021]
[Function]A detailed signal slot is formed in the optical disc which comprises only a synthetic resin materialor the optical disc which photoresist material is applied on a glass substrate and changes in this inventionmodulating the intensity of a continuous-oscillation ultraviolet laser beam.
[0022]A signal is reproduced from the signal slot immediately after formingand the above-mentioned signal slot is formed preciselycontrolling the irradiation time of the above-mentioned ultraviolet laser radiation based on this regenerative signal.
[0023]A tracking servo is performed using the adjoining signal slot formed of the above-mentioned ultraviolet laser radiationand a spindle servo is precisely performed using the signal slot or the adjoining signal slot immediately after forming.
[0024]
[Example]Hereafterthe desirable example of this invention is describedreferring to drawings. The rough composition of the optical disc manufacturing installation using the optical disc manufacturing method concerning this invention is shown in drawing 1. The master optical disk 13 in which a signal is formed in this example explains as original recording for producing the master disc used in the case of the extensive duplicate of an optical disc.
[0025]the wavelength which ejects a high-energy-density laser beam as a light source for record of a signal in the optical disc manufacturing installation shown in this example -- ********** of 280 or less nmm -- what is called the UV laser light source 1 is used. Specificallythe UV laser light source 1 is a light source which ejects the far-ultraviolet laser beam using the 4th harmonic generation of the neodium YAGU (Nd:YAG) laser whose wavelength is 1064 nm so that it may mention later.
[0026]The far-ultraviolet laser beam ejected from this UV laser light

source 1 is the continuous-wave-laser light of a single mode. It is reflected by the mirror 2 and the light flux of this far-ultraviolet laser beam enters into the acoustooptic modulation element (AOM) 3. Herethe signal from the formatter 4 is sent to the above-mentioned acoustooptic modulation element 3and a far-ultraviolet laser beam serves as a light modulation pulse by which intensity modulation was carried out based on the above-mentioned signal.

[0027]Depending on the format of the signal recordeda laser beam may be deflected by an acoustooptic deflection element etc. The above-mentioned acoustooptic modulation element 3 and an acoustooptic deflection element may not necessarily be limited to the thing using an acousto optic effectand the thing using an electrooptic effecta magnetooptic effectand the liquid crystal optical effect may be sufficient as them. Howeverwhat uses an acousto optic effect under the present circumstances is the most reliableand is low costand it is small.

[0028]Thenit is reflected by the mirror 5 and the optical beam from the above-mentioned acoustooptic modulation element 3 enters into the beam expander 6. The beam diameter of the optical beam which entered is expanded in this beam expander 6. The optical beam to which this beam diameter was expanded is irradiated by the entrance pupil side of the object lens 9 which is a condenser via the mirrors 7 and 8and a focus is adjusted appropriatelyand it is condensed on the master optical disk 13 with the spot size of a diffraction limit.

[0029]Herethe above-mentioned master optical disk 13 is carried on the spindle 14 rotated with the spindle motor which is not illustrated. Thereforeby moving the optical system containing the above-mentioned object lens 9 from a periphery to a center to the radial direction of the master optical disk 13The beam spot condensed by the above-mentioned object lens 9 is scanned by spiral shapethe master optical disk 13 is exposedand record formation of a signal is performed by from **i.e.ablation.

[0030]In this examplethe above-mentioned master optical disk 13 comprises the synthetic resin material used as a photoresist material which is mentioned later.

[0031]If the numerical aperture (NA) of the above-mentioned object lens 9 is 0.6for examplespecificallyspot diameter d condensed on the above-mentioned master optical disk 13 will be set to about 0.35 micrometer by (1) type shown below.

[0032]

[Equation 1]

[0033]At this timethe laser beam for tracking error detection outputted from the control detecting optical system 10 is condensed on the above-mentioned master optical disk 13 with the above-mentioned optical beam via the lens 11 and the mirror 8. As this control detecting optical system 10if the optical system of the optical pickup for signal regeneration from the conventional optical disc is usedit is small and can hold down to low cost.
[0034]The beam spot of the laser beam emitted from the control detecting optical system 10 on the above-mentioned master optical disk 13It enters into the above-mentioned object lens 9 at an angle which is condensed by the position which can read the signal of the above-mentioned pit in the quantity equivalent to the track pitch of the pit recorded by the beam spot of the laser beam in which intensity modulation was carried out by the above-mentioned acoustooptic modulation element 3 before 1 rotation on the master optical disk 13.
[0035]Rather than the optical pickup for signal regeneration from the conventional optical discsince the way of the focus servo optical system by the off-axis method etc. which are used for the conventional master optical disk exposure device is high degree of accuracyIt is better to use the focus servo optical system used for the master optical disk exposure device for the focus servo optical system 12 which performs the focus servo of the above-mentioned object lens 9.
[0036]Generally as a light source of the optical pickup for signal regeneration of the usual optical discnear-infrared rays or a red semiconductor laser is used. The wavelength of the laser beam by these near-infrared rays or a red semiconductor laserIt is better to amend the image formation position of the laser beam condensed by the above-mentioned object lens 9 by the above-mentioned lens 11 gradewhen the performance of the chromatic aberration correction of the above-mentioned object lens 9 runs shortsince it differs from the wavelength of the ultraviolet laser radiation through the above-mentioned acoustooptic modulation element 3 greatly.
[0037]What is necessary is for the size of the beam spot of the laser beam irradiated on the above-mentioned master optical disk 13 to adjust the efficiency NA obtained by adjusting the entering laser beam appropriatelyand just to amend it.
[0038]It is better to use a limited amendment optical system from an infinite amendment optical system as a condensing optical system containing the above-mentioned object lens 9in order to perform each above-mentioned amendment.

[0039]When the above-mentioned master optical disk 13 is produced by injection moldingare processed with accuracy sufficient about the thickness and parallelismbut. In order that accuracy may fall comparatively by curvature etc. about flatnessit is good to accustom and fix the whole surface of the master optical disk 13 to a turntable with sufficient flatness with suction forcessuch as a vacuum chuck.
[0040]Thenthe catoptric light from the surface of the above-mentioned master optical disk 13 enters into the lens 11after being reflected by the mirror 8 via the object lens 9. The light volume of the catoptric light which entered into this lens 11 is detected in the control detecting optical system 10and a tracking error signal is detected. The spot of the ultraviolet laser radiation irradiated on the above-mentioned master optical disk 13 is correctly positioned by returning this tracking error signal to the actuators 15a and 15band carrying out the movement controls of these actuators 15a and 15b.
[0041]Nextthe above-mentioned UV laser light source 1 is explained in detail using drawing 2.
[0042]From this UV laser light sourcethe ultraviolet laser radiation whose wavelength lambda is 266 nm is generated. As an excitation light source elementsemiconductor laser elementssuch as a laser diode which is not illustratedare usedand the laser beam for excitation with a wavelength [from this semiconductor laser element] of 808 nm enters into the laser medium 22 using Nd:YAG via the entrance plane of the 1/4 wavelength plate 21. ****** with wavelength selectivity which reflects fundamental laser light with a wavelength of 1064 nm which penetrated the above-mentioned laser beam for excitation to the entrance plane of the 1/4 above-mentioned wavelength plate 21and was generated by the laser medium 22 -- what is called a dichroic mirror is formed. Fundamental laser light with a wavelength of 1064 nm generated by this laser medium 22The filter 23 and the pinhole 24 are passedand after being reflected by the mirror 25 by returna second harmonic generation (SHG) is performed by entering into the nonlinear optical crystal element 27 which comprises KTP ($KTiOPO_4$) via the output coupler 26.
[0043]The 2nd harmonics laser beam with a wavelength of 532 nm generated in this nonlinear optical crystal element 27 enters into the optical isolator 30 via the clinch mirror 28 and the lens 29after being reflected by the mirror 40. In this optical isolator 30the returned light to the semiconductor laser element of the 2nd harmonics laser beam which entered is avoided.
[0044]After the 2nd harmonics laser beam through the above-mentioned optical isolator 30 enters into the phase modulator 31 for acquiring a

frequency error signal and a phase modulation is performedthe 4th harmonics laser beam with a wavelength of 266 nm is oscillated by entering into the external resonator 41 via the mirror 33. This external resonator 41 is constituted by the concave surface mirror 34the output coupler 36and the reflective mirrors 37 and 38 as a reflective means. In the above-mentioned external resonator 41the nonlinear optical crystal element 35 which comprises BBO (beta-BaB_2O_4) is arranged.

[0045]Herethe resonance frequency of the above-mentioned external resonator 41 is swept by carrying out drive controlling with the voice coil motor (VCM) which does not illustrate the above-mentioned concave surface mirror 34. The catoptric light specifically reflected by the above-mentioned concave surface mirror 34 by the 2nd harmonics laser beam which enters into the above-mentioned nonlinear optical crystal element 35 enters into the photodetector 32. In this photodetector 32the catoptric light which entered is changed into photoelectric currentand is sent to the locking circuit 39. In this locking circuit 39the resonance frequency of an external resonator is locked by the frequency by a second harmonic generation by detecting the position of the above-mentioned concave surface mirror 34 based on the sent photoelectric currentand performing position control of this concave surface mirror 34.

[0046]Thusthe 4th harmonics laser beam can be efficiently obtained from the above-mentioned nonlinear optical crystal element 35. Since ultraviolet laser radiation with an above-mentioned wavelength of 266 nm generated is continuous oscillationit can perform optical intensity modulation at high speedand its homogeneity in the mode is high. Thereforea diameter can condense easily at a spot of 1 micrometer or less. Since the power efficiency of the 4th harmonics laser beam to the output power of the semiconductor laser for excitation is acquired at about several percentif the output power of a semiconductor laser is increased to about 20Wthe output of the 4th harmonics laser beam beyond 1W can be obtained.

[0047]The portion with which the ultraviolet-laser-radiation pulse of the above-mentioned master optical disk 13 was irradiated is shaved off and removed by ********** ablationand a pit is formed. At this timemore than 0.1 MW/cm^2 needs the output of the ultraviolet laser radiation for producing ablation. Although more than 1 MW/cm^2 is preferred and it is dependent also on the kind of photoresist material practicallyif the number of rotations of the master optical disk 13the irradiation position of ultraviolet laser radiationetc. are taken into considerationthe energy density of ultraviolet laser radiation is enough if there is also 1 J/cm^2.

[0048]For exampleafter the output of the 500-mW 4th harmonics laser beam penetrates an object lenseven if it takes optical system efficiency into consideration a laser beam with an intensity of not less than 100 mW can be obtained easily. Thereforeif the spot diameter of 5-m/sec. and a laser beam shall be 0.35 micrometer the linear velocity by rotation of the above-mentioned master optical disk 13when exposing the master optical disk 13an energy density will serve as about 6 J/cm^{2}and will serve as sufficient value to produce ablation.
[0049]Therebya pit can be formed in the master optical disk 13 only by exposure. Make the conventional developing processing stage unnecessary and Thereforeinstability peculiar to a developing processing stageFor exampleall of problemssuch as heterogeneitysuch as development unevenness in fluctuation and master optical diskssuch as temperature of a developing solution and concentrationcan be solvedand dispersion in the size of pit shapes can be stopped very smaller than before.
[0050]It may be made to use what what was formed only with the synthetic resin material was used as the above-mentioned master optical disk 13and also applied the above-mentioned synthetic resin material as a photoresist film on the glass substrate.
[0051]Nextpit formation is explained using drawing 3.
[0052]In drawing 3pit $A_1A_2A_3$and ... are the pit sequences already formed of ablation. Pit B_1 is a thing under formation nowand since the above-mentioned master optical disk 13 moves to an arrow directionpit B_2 and ... will be formed further. For trackingso that a focus may be connected on pit A_1 before 1 rotation of the master optical disk 13 to pit B_1 under present formationIt is the wavelength which photoresist material does not expose and irradiates with the laser beam of intensity low enoughfor examplea semiconductor laser with a wavelength of 680 nmvia the above-mentioned object lens 9. This irradiated laser beam detects the reflected returned light by 2 division photodetectorand detects a differential signal as well as the push pull method in the optical pickup for signal regeneration from the usual optical disc. According to this differential signalthe actuators 15a and 15b which drive the above-mentioned object lens 9 to the radial direction of the master optical disk 13 are driven. Therebyby the conventional cutting machinethe accuracy of a very highly precise track pitch can be obtained to the track pitch having been determined only with the feed accuracy on an optical system table.
[0053]Detection of the tracking error signal by the tracking operation of signal record is explained using drawing 4.
[0054]For detection of the tracking error signal using the catoptric

light from the above-mentioned master optical disk 13A tracking error signal is detected by the three beam method using visible laser beams with a wavelength of 532 nm oscillated from the above-mentioned control detecting optical system 10 simultaneously with ultraviolet laser radiation with a wavelength [for the above-mentioned pit formation] of 266 nm.

[0055]Drawing 4 is a plan of the above-mentioned master optical disk 13and is seen from the optical axis direction of the laser beam with which it irradiates. For examplewhen a pit is formed as mentioned above of beam-spot B_1 of the laser beam in which intensity modulation was carried out by the above-mentioned acoustooptic modulation element 3The laser beam from the above-mentioned control detecting optical system 10 is irradiated as beam-spot $S_{B1}$$S_{B2}$and S_{B3}respectively on the adjoining pit currently formed before 1 rotation on the above-mentioned master optical disk 13. A tracking error signal is acquired by detecting the light volume of the catoptric light from the above-mentioned master optical disk 13 of this spot $S_{B1}$$S_{B2}$beam-spot S_{B2} of the both ends of the laser beams irradiated as $S_{B3}$and S_{B3}. Tracking operation can be precisely performed using this tracking error signal.

[0056]The optimal pit for signal regeneration can be formed by adjusting the optimal record light intensity from the demodulation signal level of the record signal which detected the light volume of the catoptric light from the above-mentioned master optical disk 13 of beam-spot $S_{B1}$and was reproduced.

[0057]Although the demodulation clock signal of a record signal and the arithmetic method of address information which were reproduced change with formats at the time of signal record of a constant linear velocity or a constant angular velocitySpindle servo error detection to the above-mentioned spindle 14 can be performed on the basis of the demodulation clock signal or address information of this record signal.

[0058]The beam spot further for reproduction is provided and it may be made for this beam spot for reproduction to detect a track pitch error immediately after signal record besides detecting the track pitch error of the track before 1 rotation which adjoins the track which performs signal record as mentioned above.

[0059]In order to detect a playback demodulation signal at the time of playback of a record signalit is also possible to carry out using the optical pickup for signal regeneration from the optical disc with an object lens provided independently. At this timeit is possible to perform the tracking servo error detection and spindle servo error detection by the same object lensand same error detection by combining

the object lens provided according to the aboveand the object lens 9 for record with the rigid body.
[0060]In 1 rotation eye immediately after a signal recording startSince the pit is not formed and the above-mentioned tracking servo error detection and spindle servo error detection cannot be performed1 rotation eye immediately after a signal recording start needs to perform drive controlling like the conventional master optical disk exposure deviceand needs to form a pit. From 2 rotation eyeas mentioned abovetracking servo error detection and spindle servo error detection can be performed using the pit recorded on the track before 1 rotationand quality and highly precise signal record can be performed.
[0061]In constituting the master optical disk 13 from material in which injection moldingsuch as resinis possibleBy using the master optical disk in which only the preamble carried out injection molding by La Stampa in which the pit was formedthe optical system by tracking servo error detection and spindle servo error detection is controllable by the conventional master optical disk exposure device from a signal recording start time beforehand.
[0062]Although the sensitizing agent and phenol novolak resin of a naphthoquinonediazide system which are exposed to ultraviolet rays are blended conventionally and the material melted into an organic solvent is mainly used as a kind of photoresist materialIn using ablation like this inventionphotoresist material can be constituted only from polymer resin which has sufficient absorption for the wavelength of a laser light sourcei.e.a far ultraviolet rayand it becomes possible to design photoresist material very simply.
[0063]Since the molecular weight-dependence of the photolysis at the time of ablation can be small suppressed if molecular weight distribution of this polymer resin is made narrow enoughit is expected that dispersion in pit shapes will also be stopped small.
[0064]In producing an optical disc in small lotsSince record formation of a signal can be performed to these optical discsrespectivelyusing the above-mentioned master optical disk 13 as each optical discThe making process of La Stampa using a master disc can be skippedand the manufacturing cost of the optical disc in research and development and a trial production can be reduced substantially.
[0065]By performing electroless deposition and electroforming to the master optical disk produced by the device using the optical disc manufacturing method mentioned aboveand creating La Stampathe duplicate of an optical disc can be manufactured in large quantities by the conventional methodssuch as injection molding.

[0066]The optical disc of a product is producible by producing the record board of the same size as the optical disc of a product using the material in which injection moldingsuch as resinis possibleperforming signal recordand forming a reflection film and a protective film to this optical disc by which signal record was carried out.
[0067]Since the method of forming a signal in an above-mentioned optical disc manufacturing installation is removal processing by ablationthe eliminated material dispels and the reattachment may be carried out on a master optical disk. Howeverthis material that dispelled serves as an ultrafine particlesince the size of this ultrafine particle is far smaller than the size of a signal slotto the noise level of a regenerative signalit is only influencing a little and there is no big influence which results in lack of a signal. Howeversince there is a possibility of polluting the inside of a device with this ultrafine particle adhering to the inside of an optical disc manufacturing installation and an object lensIt is good to establish the nozzle on the pipe which blows off a gaseous jet in the spot irradiation position near the object lensor an annulus ringand the suction port on the pipe which absorbs the jet of this gas efficientlyor an annulus ringand to collect the above-mentioned ultrafine particles.
[0068]Nd which ejects a laser beam with a wavelength [by the 4th harmonic generation] of 266 nm using a laser beam with a wavelength of 1064 micrometers as a UV laser light source of the above-mentioned example : although the YAG laser is used$Nd:YVO_4$ which ejects the laser beam by the 4th harmonic generation with a wavelength of 266 nm from a laser beam with a wavelength of 1064 micrometers as other solid state laserNd:YLF which ejects the laser beam by the 4th harmonic generation with a wavelength of 262 nm from a laser beam with a wavelength of 1047 micrometersNd:YAP which ejects the laser beam by the 4th harmonic generation with a wavelength of 270 nm from a laser beam with a wavelength of 1079 micrometersetc. can be used.
[0069]In the above-mentioned examplealthough KTP and BBO are used as a nonlinear optical crystal elementLNQPM LNLBOKNetc. other than these can be used.
[0070]In the above-mentioned examplealthough tracking detection is performed using the three beam methodit is also possible to use the push pull method.
[0071]
[Effect of the Invention]The optical disc manufacturing method concerning this invention so that clearly also from the above explanationSince a signal slot can be formed only by exposing a master

optical disk by carrying out intensity modulation of the continuous-oscillation ultraviolet laser beamirradiating with itand forming a signal slot on the optical disc which absorbs ultraviolet laser radiation and in which a signal slot is formed by from **The conventional photoresist application process and developing processing stage in a making process of a master optical disk can be made unnecessaryand the change and dispersion of pit length by the instability in a developing processing stage can be lost. A cutting process can be simplified substantially.

[0072]The laser light source from which the optical disc manufacturing installation concerning this invention ejects a continuous-oscillation ultraviolet laser beamThe modulation means which modulates the intensity of the ultraviolet laser radiation from the above-mentioned laser light sourceand the optical means converged on the master optical disk which absorbs the ultraviolet laser radiation from the above-mentioned modulation meansand in which a signal slot is formed by from **By having a control means which controls the irradiation time of the above-mentioned ultraviolet laser radiation to the above-mentioned optical discand forming a signal slot on the above-mentioned optical discSince the process devices installed in the clean room for producing a master optical disk are substantially reducibleconstruction costadministrative and maintenance expenseinstallation occupation areasetc. of a production line can be reduced substantiallyand the manufacturing cost of a master optical disk can be reduced.

[0073]Since the master optical disk itself can carry out injection molding here by applying a synthetic resin material or photoresist material on a glass substrate as for the above-mentioned optical discThe master optical disk itself can be easily produced very cheaply by the same process as the case where an optical disc is reproduced using La Stampa. Since a master optical disk can be made throwing awaythe recycling process of a master optical disk becomes unnecessary.

[0074]The above-mentioned ultraviolet laser radiation can form a signal precisely by continuous-wave-laser light by being a far-ultraviolet laser beam by the 4th harmonic generation of neodium YAGU (Nd:YAG) laser.

[0075]By playing a signal using an optical pickup from the signal slot immediately after forming of the above-mentioned ultraviolet laser radiationand controlling the irradiation time to the above-mentioned optical disc of the above-mentioned ultraviolet laser radiation based on this regenerative signalSince the exposure conditions of an ultraviolet laser beam can be adjusted so that the quality of a regenerative signal may serve as bestthe optimal signal slot can perform signal record and a

quality control becomes easy.
[0076]By performing a spindle servo using the signal slot or the adjoining signal slot immediately after having performed the tracking servo using the adjoining signal slot formed of the above-mentioned ultraviolet laser radiationand moreoverforming of the above-mentioned ultraviolet laser radiationSince the adjoining accuracy of the track pitch of a track and the accuracy of a rotation jitter can be raisedit is possible to carry out simple [of the drive mechanism part]a manufacturing cost can be held down and a highly precise master optical disk can be produced.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1]It is a figure showing the rough composition of the optical disc manufacturing installation concerning this invention.
[Drawing 2]It is a figure showing the rough composition of a UV laser light source.
[Drawing 3]It is a figure for explaining pit formation.
[Drawing 4]It is a figure for explaining tracking operation.
[Description of Notations]
1 UV laser light source
3 Acoustooptic modulation element
9 Object lens
10 Control detecting optical system
13 Master optical disk
14 Spindle
15a and 15b Actuator
33 Photodetector